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Of the eastern genera, seven extend into Kansas but do not reach Mexico: Boltonia, Silphium, Echinacea, Lepachys, Cacalia, Lactuca, and Rudbeckia. The latter extends into the Rocky Mountains. These genera are but sparsely represented on the plains, being found in Kansas mostly in the eastern part.

Fifteen Eastern genera extend into Mexico, but not west of the plains: Elephantopus, Vernonia, Kuhnia, Liatris, Heterotheca, Polymnia, Iva, Eclipta, Heliopsis, Verbesina, Actinomeris, Coreopsis, Bidens, Helenium, and Erechtites.

Four genera of the southeast region extend as far north as Kansas, and all but the first also into Mexico: Marshallia, Hymenopappus, Gaillardia, and Pyrrhopappus.

Ten genera are common to Mexico and the plains, but are not found in the other regions. These 10 genera, many of which are not found north of Kansas, throw much light on the relation of the Kansas flora. These genera are: Gutierrezia, Amphiachyris, Grindelia, Aplopappus, Aphanostephus, Evax, Engelmannia, Zinnia, Thelesperma, and Dysodia.

This relation is shown in a different form by the following summary of the 47 genera under consideration:

Common to Kansas and Mexico, 31 genera.
Common to Kansas and northeast region, 23 genera.
Common to Kansas and southeast region, 28 genera.
Common to Kansas and Rocky Mountains, 8 genera.

We see from these tabulations that our flora has more in common with Mexico than any other region. Ten genera have extended only along the plains; three, also, into the Rocky Mountains; three along the plains and into the southeast region; 15 have spread more or less throughout eastern North America. Geographically, Kansas is much more closely related to the portion of the United States east of the Mississippi than it is to Mexico, yet we have only seven genera common only to the two former, while we have 10 common only to Kansas and Mexico. The small number of northern and mountain genera is also very noticeable.

This relation of the Kansas flora to the Mexican is undoubtedly closely connected with the receding of the glacial epoch. As the arctic forms withdrew northward or into the mountains, their place was taken by forms from the south. As was pointed out by Doctor Watson (Proc. A. A. A. S., vol. XXXIX), the Mexican flora is more closely related to not only the plains, but the whole Atlantic region, than to the Pacific or Great Basin regions. Doctor Britton (l. c.) arrives at the same result by a tabulation of the orders of phanerogams.

SOME NOTES ON CONDENSED VEGETATION IN WESTERN KANSAS.

BY MINNIE REED, MANHATTAN, KAS.

It is a well-known fact that the geographical position of a plant determines its habits and peculiarities of appearance; that is, we expect to see a certain kind of vegetation in the tropics, another in the temperate zone, and still another in the frigid, just as we expect to see different races or types of the human family in the different zones. This variation of plants in different localities of the same zone is almost as striking in some instances, and often plants belonging in the same family, or even the same genus, are frequently so different in appearance as to be almost unrecognized by the amateur botanist.

Take, for instance, the mountain and valley flora, or those of the swamp and arid, dry region, and compare them. Though these may all grow in the same latitude, or even in the same State and county, they are so different as to be noticed immediately by the very casual observer, while a botanist would be able to tell at once where the plant grew — in a dry or a moist situation.

It is because of this fact that we associate the stately palms, the graceful tree ferns and the magnificent Victoria regias with the hot, moist climate of the tropics. For the same reason, we associate deciduous trees, like the oak, elm, or hickory, the dainty ferns and the fair, sweet water lilies of our own ponds, with the temperate zone; or the pines, ferns, hemlocks and balsams with the colder parts of this zone. If our imagination travels further and further northward, we think of the scant vegetation of mosses and lichens, or the great fields of perpetual ice and snow, covered with microscopic plant forms only.

All these things point out and verify the law of the survival of the fittest; for we know that the great, large-leaved, succulent plants of the south, with their tender, naked buds, could not live where there was ice and snow. Nor would you expect to find the vegetation of the warm, moist tropical regions so small, or the buds of trees so carefully protected from frost and cold by varnished or wooly scales, when there is no frost or snow.

Every part of a plant has some use, and every peculiarity some advantage, so that we could not expect any modified part for protection, when there is no need for that protection.

Thus, after years of evolution, (or adaptation, if you are pleased so to call it,) the flora of each region has come into harmony with its environments, and we have a type of plants best suited to their habitation.

With these general principles in mind, we would scarcely expect to find any large, thin-leaved plants out in the dry, arid regions of western Kansas. It is the absence of these that perhaps impresses us most when we first become acquainted with the flora of this section.

Looking across the level prairies of Greeley county, everything seems to be a dull, monotonous, grayish-green hue, instead of the vivid fresh green of our prairies in eastern Kansas. Again, if we notice, the prevailing color of the flowers is yellow, with a few dull, purplish-red ones intermixed. In fact, we are forcibly reminded of our own autumn colors, though these are midsummer flowers. Are these colors due to the higher altitude, dry climate, or the very cool nights, or to all three combined?

If we study more closely, we will notice that most of the plants are Compositæ, which are usually yellow or purplish, while the grayish tint of the prairies is largely due to the hairiness of the leaves, as most plants are more or less hairy, scabrous or resinous in this region. Indeed, one rarely finds a glabrous, thin-leaved plant, and that is usually resinous or viscid. One will also find the leaves of almost every plant either finely divided or very much reduced, many being very narrowly linear, subulate, or even simple scales and spines. In fact, the whole plant is reduced, and often less than one-fourth the size of sister species in the eastern part of our State.

The fierce struggle for moisture is everywhere apparent, from the size and form of the plants. Of course, that plant that can endure the burning sun and the hot winds longest has the greatest advantage, thrives best, and usually crowds out its less hardy companions that are unable to fit themselves so well to their environments.

The following plants are the most noticeably condensed of the western Kansas flora, and form very strong contrasts with Eastern species:

First, in the order Cruciferæ, instead of our ordinary Nasturtium sinuatum Nutt. Sisymbrium canescens Nutt., and S. officinale Scop., we find there only two species abundant, and both very pale, with reduced, finely-divided foliage. These two species are Erysimum parviflorum Nutt. and Lepidium virginicum L., the former almost leafless in the extreme western counties; the latter very small, many times scarcely four inches high.

Our common purslane, Portulaca oleracea L. (an introduced species), with its thick, fleshy branches and leaves (a single plant often being over three feet in diameter), is replaced in this dry region by the tiny, hairy Portulaca pilosa L., which is less than four inches in diameter.

In the order Malvaceæ, or mallow family, we have in eastern Kansas Abutilon avicennæ Gaertn, (which, though introduced, is very abundant in our meadows,) also Hibiscus militaris Cav. and Callirrhoe involucrata, all of which are from one to four feet high. These are replaced in the West by a single species, Malvastrum coccineum Gr., which is seldom more than six inches high, and has small-lobed, thick, hairy leaves, and grows procumbent instead of upright, as most of the Eastern species.

The Western Linaceæ are Linum sulcatum Ridd. and Linum rigidum Pursh.; the former from 1 foot to 1½ feet tall, very slender, with very few narrow leaves, while the latter is scarcely three inches tall, very bushy and scraggy, and also quite rigid, the leaves being almost subulate.

The Leguminosæ are represented by such plants as Dalea aurea Nutt. and Dalea laxiflora; the first covered with long, silky hairs, and very few small, pinnate leaves; the latter rather tall, but slender, with small leaves, and numerous branches near the top. Also, Psoralea argophylla Ph., and P. tenuiflora Ph., besides several fine-leaved or hairy Astragali. Astragalus bisulcatus Gr., A. pectinatus Dougl., A. flexuosus and A. macrolobus having fine foliage, and Astragalus mollissimus Torr. with rather large leaves, but very hairy.

Our common evening primroses, of the order Onagraceæ, are entirely replaced by hairy, grayish-colored, narrow-leaved, dwarfed species, most of them less than a foot high, and most of them but three or four inches. The species found in this dry region are: Œnothera triloba Nutt., Œnothera fremontii Watson, Œ. hartwegi Benth., Œ. pinnatifida Nutt., and the beautiful little Œnothera canescens Torr., which grows flat on the ground and has such dainty pink, variegated blossoms, as fragrant as violets. In this same order, also, is found Gaura coccinea Nutt., which is very abundant in cultivated portions of this dry region. This plant is usually not more than six inches high.

The most striking example of condensed vegetation is seen in the order Cacteæ, which is represented in western Kansas by three or four genera. In this order the leaves are reduced to spines, or minute scales, while the thick, fleshy stems contain chlorophyll, and the epidermis is furnished with stomata, so that they perform the functions of leaves. Common species of this order are: Opuntia missouriensis DC., O. rafinesquii Eng., O. arborescens, of the prickly-pear family; and Mamillaria vivipara Haw., M. missouriensis DC., and M. dasyacantha, of the ordinary round species. These vary in size from scarcely an inch in diameter, in some of the Mamillaria, to 10 or 15 inches in length, in the prickly-pear family.

The order Compositæ is most fully represented in that region, yet most of these are the typical grayish, hairy, narrow-leaved plants peculiar to the Western flora.

Liatris squarrosa Willd., very common there, is from 6 to 12 inches high, rigid and glabrous, while our L. punctata, and L. spicata Willd., and others common here, are from one to five feet in height, and proportionately larger.

Aplopappus spinulosus DC., a grayish, scabrous plant, with deeply serrate, lanceolate leaves, is a composite, as common as the sunflower here, though very much smaller, seldom exceeding six inches in height.

Thelesperma gracile Gr. and Hymenopappus tenuifolius Pursh., both slender plants, with very few pinnatifid, hairy leaves, are also quite common there.

The asters there all have fine foliage, and either hairy or viscid. Aster multiflorus Ait., A. ericæfolius, and A. tanacetifolius HBK., are the chief representatives. The first two have almost subulate leaves, rigid and thick, and the entire plant from 3 to 10 inches high, contrasting very strongly with our Eastern asters, from one foot to six feet tall, as A. salicifolius Ait., A. paniculatus Lam., and A. cordifolius, all of which have very thin, smooth leaves.

Our common Echinacea purpurea Moench is replaced by E. augustifolia DC., which is densely hirsute, and from three to six inches tall.

The Helianthi are usually about one-half as tall as ours in eastern Kansas. I collected many specimens of Helianthus annuus L., in blossom, that were scarcely six inches tall, and proportionately small.

Another Compositæ is the Lepachys columnaris Torr. & Gray, and its variety pulcherrima Torr. & Gray and L. tagetes Gr. Both have thick, slightly viscid, pinnatifid leaves. The variety pulcherrima is not very common, being comparatively rare, while the other two are very abundant, taking the place of our L. pinnata Torr. & Gray.

Baccharis wrightii is another example of almost leafless plant, the leaves being almost spines, subulate, short, and rigid, while Lygodesmia juncea Don. is perhaps the most striking example of all, or at least in the order Compositæ. This plant somewhat resembles a common rush, but is rather diffusely branched, entirely destitute of foliage, bearing a small pink flower on the tip of each stiff branch, which look very odd on such a naked plant.

The order Asclepiadaceæ is represented by the two extremes: the little, narrow-leaved Asclepias verticillata Gr., var. pumila Gr., from three to eight inches tall, and the large-leaved, rather tall species, Asclepias jamesii.

In Boraginaceæ, there is Krynitzkia jamesii, scarcely six inches high, very hairy, and gray, with a spiny fruit.

The Solanums are S. rostratum, common here, and S. triflorum, with finer, smooth foliage.

The Penstemons are P. albidus Nutt. and P. gracile Nutt., both about six inches tall; while our common P. grandiflora Nutt. and P. tubiflorus Nutt. are from one to three feet. Our common Plantago major L. is entirely replaced by the little gray, hairy species, P. patagonica, varieties gnaphalioides and aristata, from two to six inches, with narrow, grass-like, hairy leaves.

The order Nyctaginaceæ is represented by Oxybaphus angustifolius Sweet, also narrow-leafed, slender, and seldom ever more than a foot tall. Our O. nyctagineus Sweet often exceeds three feet, and has oval leaves.

In the order Illecebraceæ, there is the whitish plant, scarcely three inches high, called Paronychia sessiliflora. Its white appearance is due principally to the silvery, scarious bracts, which equal or exceed the short, narrow leaves. It grows in close mats in the gypsum banks, being almost the same color.

In Chenopodiaceæ is found the ordinary Chenopodium album L., though somewhat reduced in size, and smaller foliage, and Cycloloma platyphyllum Moq., and Corispermum hyssopifolium L., both with reduced foliage, almost scale like, or spines. The Cycloloma is hairy, the Corispermum coriaceous, and but a few inches high.

The order Gramineæ is well represented in this region, as well as farther east, but they are rigid and wiry, and have the characteristic dull, grayish color.

Of course, the buffalo grass, Buchloe dactyloides Englm., is the most common.

Its short, bunchy manner of growth and monotonous gray tone are familiar to every one who has been across the plains.

Aristida purpurea Nutt., Bouteloua racemosa, B. hirsuta, B. oligostachya Torr., Schedonnardus texanus Steud., and Munroa squarrosa Torr., are all very common on the prairie, and many of them somewhat hairy or scabrous.

There might be a great number of others added to this list, to illustrate the general tendency of Western plants towards condensation of both leaf and stem, but these amply illustrate this peculiar feature of the flora of a dry, arid region.

The question that immediately occurs to the mind is: of what advantage are all these peculiarities to a plant? Perhaps the first answer to occur to you is that insufficient moisture and poor soil will naturally produce dwarfed or stunted plants. Yet this does not explain either hairiness, or narrow foliage, or resinous coatings.

There are five or six peculiarities to be explained in these condensed plants, all interesting, and all explainable more or less satisfactorily.

From the above comparisons of Eastern and Western species, the following peculiarities have no doubt been noticed: Their reduced size; their hairy, wooly or resinous covering; their rigidity and their finely-divided foliage; and the entire absence of leaves on some of the plants.

Aside from the dwarfing effect of drouth, there must be a reason why these peculiarities are so strongly developed. Sir John Lubbock says every leaf form and every special modification of any part has some special purpose or advantage for the plant.

This consolidation or condensation of plants, by shortening stems, thickening leaves, or the substitution of fleshy, solid plants without foliage, of course reduces the surface for evaporating moisture, and respiration and transpiration both take place more slowly. Compare an ordinary prickly-pear cactus with any leafy weed, like the Chenopodium, for instance, and note the vast difference between them in the amount of surface exposed to sun and air for evaporation.

This reduction of surface for evaporation or transpiration is the chief advantage in the consolidation of the cacti in such a compact form, while the spines and prickles protect them from the grazing animals that roam over this section devouring every green herb. The rigidity and hardness of some other species probably serve the same purpose.

The hairy or resinous covering of leaves and stems forms protecting covers for the stomata, preventing too rapid transpiration.

The advantages of narrow or finely-divided foliage may be more than one, and are so easily explained. Sir John Lubbock says, in his lecture on leaves, that large, thin leaves are usually found in moist regions, protected from strong winds. Mrs. W. A. Kellerman suggested this point in a paper ("The Evolution of Leaves") read before the Academy several years ago. The point suggested by these two writers gives us the clue to the explanation of the finely-divided foliage of this dry, windy region. It has been previously stated that large, thin leaves are easily injured by strong winds passing through them, while thinly-divided, rigid leaves would allow the passage of the wind freely, without any injury to the foliage. The winds are very strong and constant in all this dry region; hence the need of the finely-divided or linear foliage.

There is still another means of reducing evaporation that occurred to me while studying these Western plants. Might we not most naturally expect smaller stomata, more deeply imbedded, and a small ernumber per square inch of surface, on Western plants than on our Eastern species, growing in a more moist climate? Thinking this most probably the case, I began immediately to measure and compare stomata on plants from both West and East, taking those of the same species or genus for comparison.

I have not yet completed a tabulated list of 100 specimens, so cannot as yet give my figures or draw definite conclusions. The results thus far seem somewhat confusing, but I am still inclined to think they will verify my supposition, for I find the stomata not only more distant, but somewhat smaller, on Western plants. When I have finished measuring and comparing my list of plants, I can draw more definite conclusions.

Other interesting things in regard to stomata were also noticed in my study. Almost every narrow-leafed plant studied had stomata on both surfaces of the leaf, as well as on the stem. The grasses and parallel-veined leaves have long, narrow stomata, arranged with their major axis parallel to the major axis of the leaf, while the stomata of the net-veined leaves seemed to be scattered irregularly over the surface, regardless of the axis, and somewhat broader than those of the narrow leaves. When there was any difference between the stomata of the upper and under surfaces, those on the lower were broader, in many cases being almost round.

This subject is very interesting, and there is much yet to be learned about stomates, their arrangement, distribution, and size, and their connection with the habits or location of various plants. This subject may have been well studied, but if it has been I am unable to find any literature on the subject. This study is very fascinating, so that any botanist cannot help enjoying it or discovering new facts.

It is to be hoped that other botanists will study the peculiarly Western types of our Kansas flora, and add something definite to our knowledge of their habits, structure, and forms.

ADDITIONS TO THE FLORA OF KANSAS.

BY B. B. SMYTH, TOPEKA.

The following species and varieties of plants, not heretofore reported, have been found growing within the State during the past two years, and are therefore added to the list of Kansas plants. Descriptions are given, as far as possible, of all plants not described in Gray's Manual (6th edition), or Coulter's Manual of Rocky Mountain Botany. Many of the descriptions are obtained from Coulter's Manual of the Phanerogams and Pteridophytes of Western Texas, being Contributions from the United States National Herbarium, vol. II. Descriptions of some of the plants are not at hand, and their existence in the State, though here reported, is not absolutely certain.

FLOWERING PLANTS.

1. Anemone patens L.: Linn county (Mrs. A. H. Merrell).

2. Delphinium carolinianum Walter: Stems 3 to 6 dm. high, slender, often softly pubescent; leaves deeply 3- to 5-parted, the divisions two to three times cleft; the lobes all narrowly linear; raceme strict; flowers whitish; spur ascending; pods erect. Frequent on rocky hillsides; our most common delphinium; heretofore known as D. azureum Mx. (Smyth).

3. Delphinium scopulorum Gray: Pottawatomie county (collected by F. F. Crevecœur, and determined by Prof. L. H. Dewey).

4. Draba caroliniana Walt., var. micrantha Gray: Franklin county (collected by Prof. W. E. Castle).

5. Erysimum asperum DC., var. arkansanum Gray: Sherman, Wallace, Finney and Hamilton counties (S.)